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A Method for Controlling Flow Localization in Machining Processes

Innovative cutting tools and constrained chip formation processes minimize plastic flow localization, resulting in enhanced surface quality, higher production yields, and reduced manufacturing costs.

Local strains and strain rates in the shear band are essential for understanding microstructure development and temperature rise in manufacturing processes. Adiabatic flow localization in the form of shear bands limit the high strain-rate deformation capacity of metals. The conditions underlying shear band formation are also of extraordinary interest for developing methods for their control in manufacturing processes. Currently, research on all forms of inhomogeneous deformation (flow localization) and related processes focuses on understanding and characterizing the localization phenomena. However, quantitative knowledge of the local deformation is still insufficient.

Researchers at Purdue University have developed cutting tools and machining processes that minimize or eliminate various forms of plastic flow localization of metal alloys. Reduction in load-bearing capacity in chips arises from slip, similar to the sliding of a stack of cards, within the chip. Suppressing the unconstrained flow in the chip thickness will limit the flow localization. Therefore, it is feasible to enhance the quality of component surfaces through design of tools with a constraining edge and constrained chip formation processes. Furthermore, cutting speeds can be enhanced, while avoiding localization, enabling increases in productivity.

Advantages:

-Improved quality of machined surfaces (finish, tolerances, material properties, etc.)

-Improvements in production rate and production yield

-Reduce manufacturing cost resulting from the reduction of scrap components

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-Machining

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